

WOOD FROG AND SPOTTED SALAMANDER EGG MASS COUNTS AND PERCENT VERNAL POOLS OCCUPIED BY AMPHIBIAN SPECIES ON DOI LANDS IN THE NORTHEASTERN UNITED STATES

1. Background

Concerns over amphibian declines and malformations have necessitated increased monitoring efforts for amphibians (Heyer et al. 1994, Olson et al. 1997). Vernal pools are an essential habitat for amphibians and other organisms (e.g., fairy shrimp, Blanding's turtles, spotted turtles) in the northeastern United States. Vernal pools have typically received little or no protection, are easily overlooked, and are often degraded or destroyed when they are dry (Hunter et al. 1999). Because vernal pools are susceptible to degradation and loss, amphibians reliant on these wetlands are particularly vulnerable (Vial and Saylor 1993). Currently, several states in the northeastern United States (Massachusetts, New Hampshire, Maine) have recognized this problem and are identifying, documenting and certifying vernal pools (Kenney 1995, Tappan 1997, Calhoun 1997). For these state programs, volunteers record whether spotted, Jefferson, and blue-spotted salamanders and wood frogs (chorusing, amplexant pairs, egg masses, larvae) are present in vernal pools.

One factor making it difficult to conduct vernal pool surveys is that these pools are often not mapped. Most do not appear on National Wetlands Inventory (NWI) maps because they are typically smaller than the minimum $\frac{1}{4}$ to $\frac{1}{2}$ -acres required for wetlands to be mapped. If they do appear on NWI maps, they are likely designated as palustrine emergent, forested, scrub-shrub, or unconsolidated bottom. Three options exist to determine the presence of vernal pools: 1) site visits, 2) evaluating high quality, large-scale, color-infrared aerial photos (and NWI maps), or 3) evaluating local geology, topography and soils.

Spotted salamanders

Petranka (1998) highly recommends focusing on spotted salamanders (*Ambystoma maculatum*) for long-term amphibian monitoring programs because they are so widespread, well-studied, and can serve as a "poster salamander" for the health of vernal pool-forest ecosystems. Ambystomatid salamanders (mole salamanders) require both wetlands (usually vernal pools) for breeding and surrounding upland woodlands, where they spend about 95% of their lifetime burrowed underground, for survival (Semlitsch 1998). Protecting these wetlands, as well as a 164-250 m radius of deciduous forest around them, is critical for maintaining healthy populations of Ambystomatids (Robinson 1995, Petranka 1998, Semlitsch 1998). In a landscape context, it is also critical that forest corridors connecting vernal pools or stepping-stone vernal pools are available to maintain metapopulations (Gibbs 1993). According to Petranka (1998, p. 87), "local populations of this and other *Ambystoma* populations are becoming increasingly isolated from one another as habitat fragmentation, deforestation and loss of vernal pools reduce gene flow among demes" as well as reduce the ability of salamanders to recolonize areas where populations may have gone extinct.

Spotted salamander populations have been declining over the past decade in eastern Virginia. Acid deposition and associated metal toxicity may play a role in these declines (Freda and Dunson 1986; Blem and Blem 1989, 1991; Freda et al. 1991). In Pennsylvania, the number of spotted salamander eggs in a vernal pool was correlated with pH and pond size, and negatively correlated with total cations and silica (Rowe and Dunson 1993). However, Cook (1983) surveyed 13 ponds in Massachusetts and found no relationship between spotted salamander embryonic mortality and pond pH. In the Great Smoky Mountains National Park from 1993-97, Petranka et al. (1995) documented a

436% increase in spotted salamander egg counts at three sites. Turtle (2000) found that deicing salts used for highway maintenance contaminated roadside vernal pools and were a possible factor in reduced embryonic survival in these pools compared to pools away from roads. Roads are known to have deleterious effects on amphibians through direct mortality (Fahrig et al. 1995) or as potential barriers to movement (Cooke 1988). Egan (2001) reported that egg mass numbers of spotted salamanders decreased when road density exceeded 19 m/ha.

Wood frogs

Wood frogs, which also breed in vernal pools and are explosive breeders, are also good indicators of the health of vernal pool ecosystems and metapopulation landscape issues. Crouch and Paton (2000) found that egg mass counts of wood frogs are an effective means to monitor wood frog populations, as they are a relatively accurate and precise survey technique. They found that egg mass counts were highly correlated with numbers of females and males entering a pool. Wood frogs are vulnerable to acidification, habitat destruction and fragmentation (Gibbs 1998a,b), and runoff of highway road salt (Hunter et al. 1999). For example, deMaynadier and Hunter (1998, 1999, 2000) showed that wood frogs and other amphibian species were less abundant where clear-cutting had created abrupt edges and reduced canopy cover and ground leaf litter around vernal pools. Clear cutting edge effects can occur up to 35 m (115 feet) of vernal pools. Those with a forest buffer less than this will be abandoned as breeding sites by wood frogs and other amphibians. In two observed cases, wood frog and spotted salamander egg development were arrested by runoff of salt applied to highways after late spring ice storms (Hunter et al. 1999). In the Great Smoky Mountains National Park from 1993-97, Petranksa et al. (1995) documented a 68% decline in wood frog egg counts at three sites. Egan (2001) reported that egg mass numbers of wood frogs decreased when road density exceeded 12 m/ha.

2. Amphibian Monitoring and Research Questions to Address

Are the numbers of wood frog and spotted salamander egg masses and the percent of vernal pools occupied by various amphibian species:

- 1) increasing, decreasing, or staying the same over time?
- 2) related to surrounding land use and cover, road density or distance to nearest road, and proximity to or density of other potential breeding sites?
- 3) related to water quality variables, hydroperiod, or climatic conditions?

3. Requirements for Participation

- Locality (Refuge or Park) must have at least **FOUR vernal pools that support wood frog and/or spotted salamander populations.**
- **Two people are required to conduct the surveys during the breeding season** (mid-Feb to mid-May, depending on geographic location).
- **Training is mandatory.** At least one refuge biologist or staff member who will be conducting the surveys must attend a training session for the vernal pool surveys. Those who participated in the study in 2001 do not require additional training, but must read the new protocols carefully and follow them. **New Refuge participants for 2002 must attend a one and a half-day training session to be held at the Patuxent Wildlife Research Center (Laurel, MD) in**

early to mid-March (dates to be determined based on weather and when most participants are available). Travel costs will be provided by the USGS.

- **Surveyors must follow protocols.** If there are questions/concerns or problems in following the protocols, contact Robin Jung (robin_jung@usgs.gov; 301.497.5875) to determine a course of action.

4. Study Sites, Sample Size, and Time Frame

Pick **FOUR FOCAL VERNAL POOLS** that are geographically spread out in the Refuge or Park. Ideally, we would like to pick **TWO POOLS CLOSE TO ROADS, development or unforested areas (≤ 50 m)** and **TWO POOLS FAR FROM ROADS, development or unforested areas (> 100 m)** in an effort to determine effects of these landscape features on vernal pool breeding amphibians. Try to pick vernal pools that: 1) have populations of **both** wood frogs and spotted salamanders, 2) are not too large (avoid pools > 25 -30 m width or length), 3) are not too overgrown with vegetation (e.g., shrubs, emergents) making it difficult to find or see egg masses, 4) are not too deep (pick pools < 1.3 m in depth).

We will conduct **TWO types of surveys** based at and around the **FOUR FOCAL VERNAL POOLS**.

- 1) We will conduct **EGG MASS COUNTS** using a **DOUBLE-OBSERVER DEPENDENT** technique at the **FOUR FOCAL VERNAL POOLS**.
- 2) We will conduct a **PERCENT VERNAL POOLS OCCUPIED** approach to look at presence or absence of amphibian species at vernal pools surrounding **TWO of the FOUR FOCAL VERNAL POOLS**. Pick ONE pool that is close to a road, and ONE pool that is far from a road. We will survey for **OTHER VERNAL POOLS within a 250 m RADIUS** of each of these two focal vernal pools, recording locations of these pools, and then revisiting these pools **FOR A TOTAL OF FOUR TIMES EVERY ONE TO TWO WEEKS** to determine **PRESENCE or ABSENCE of AMPHIBIAN SPECIES**.

According to Berven (1990), numbers of wood frog egg masses in breeding ponds vary annually with a CV of approximately 95%. Based on data from Clay (1997) and Petranks and Smith (1995) (summary available at <http://www.mp2-pwrc.usgs.gov/ampCV/>), the mean CV for spotted salamander egg mass counts is 37%. Basing sampling protocols on the most variable species (wood frogs) and power analyses presented by Gibbs et al. (1998), monitoring 30 pools for wood frogs annually over a 10-year period should yield sufficient power (greater than 90%) to detect a population decline of 50%. Our sample size (4 vernal pools x 26 Parks and Refuges) may be as high as 104.

In order to survey both species, below are rough recommended time frames. There can be considerable annual variation in breeding times, and even within a given Park or Refuge, the breeding phenology can vary quite a bit among vernal pools only kilometers apart. The most important thing is to be attuned to the weather. Wood frogs and spotted salamanders migrate to ponds in the winter and early spring to breed on rainy or foggy nights when night air temperatures are above 10-12°C. Often, wood frogs call during the daytime as well.

State	Time Frame	Reference
West Virginia	mid-Feb to late March	Wright and Wright 1949

Maryland	mid-Feb to mid-April	Berven 1990
Massachusetts	early March-20 April	Wright and Wright 1949
Connecticut	March-April	Woodward 1982
New York (Ithaca)	March 19-April 30	Wright and Wright 1949
Southern Maine	late Mar to mid-April	McCollough 1993
Northern Maine	late April to mid-May	McCollough 1993

I. EGG MASS COUNTS

Egg mass counts should be conducted at each of the **FOUR FOCAL** vernal pools. **Each pool should be monitored closely to determine the best time to conduct the egg mass counts. Our goal is to try to obtain counts when the MAXIMUM number of eggs are present at the pool, allowing us to get the best picture of the OVERALL CUMULATIVE REPRODUCTIVE OUTPUT for each vernal pool. THIS WILL REQUIRE CONDUCTING THE EGG MASS COUNTS TWICE (OR MORE) ONE OR TWO WEEKS APART (again, depending on the weather) AROUND OR JUST AFTER THE TIME WHEN YOU OBSERVE THE MAXIMAL BREEDING ACTIVITY.**

The Egg Mass Count data sheet has a grid in order to map the site and egg mass locations. It is best to Xerox these data sheets onto Rite-in-the-Rain® paper. When you first get to the site, draw a **site map with landmark features** (e.g., fallen trees, islands) onto the grid to make drawing the egg mass locations on the map easier. Egg mass counts are best conducted during the day when the sun is out (9 am – 3 pm). When it is darker out, it is harder to see into vernal pools, particularly those that are stained by tannic acid from decaying leaves. Both observers should start at the North End of the Pond and circumnavigate the pond together in a clockwise fashion. Use polarized glasses to minimize sun glare and to aid in detection of egg masses. Use a visual/tactile method to count egg masses, using eyes and hands (cupping under the egg mass) to count and feel the egg masses in the pond. An optional method for wood frog egg masses is to use a twig to lightly touch the top of an egg mass and jiggle it gently once to determine individual egg masses. However, it is extremely important to disturb the egg masses as little as possible during the survey. Observers must walk very slowly through the entire pond. Most egg masses are near the edges of the ponds, but egg masses can also be in the middle of ponds, particularly shallow ponds.

The **DOUBLE-OBSERVER DEPENDENT** (Cook and Jacobson 1979, Nichols et al. 2000) technique is described as follows: OBSERVER 1 counts and points out egg masses to OBSERVER 2. OBSERVER 2 records what OBSERVER 1 reports, but also writes down in a separate column any additional egg masses that OBSERVER 1 missed. **OBSERVER 2 DOES NOT MAKE ANY COMMENTS TO OBSERVER 1 ABOUT THE COUNTS.** The **Double-Observer Dependent** method allows calculation of detection probabilities for each observer, thus providing adjusted population estimates for the number of egg masses in the pools (Cook and Jacobson 1979, Nichols et al. 2000). **IT IS VERY IMPORTANT TO SWITCH THE ROLES OF OBSERVERS HALF-WAY AROUND THE VERNAL POOL.** For example, if Al Zelle is Observer 1 for the first half at Sally Pool, then he should be Observer 2 for the second half of Sally Pool. Indicate when Observers switch roles on the data sheet by drawing a line after counts on the data sheet (see example data sheet).

II. PERCENT VERNAL POOLS OCCUPIED

The **PERCENT VERNAL POOLS OCCUPIED** approach we are starting this year is an important methodological and statistical approach to determining: 1) species detectability and 2)

spatial distributions and metapopulation dynamics of amphibians. The basic principle we are following is to conduct **MULTIPLE VISITS TO VERNAL POOLS DURING A SEASON**. In this study, we will first **LOCATE VERNAL POOLS** within a **250 METER RADIUS (CIRCLE) AROUND TWO OF THE FOCAL VERNAL POOLS (PICK ONE of the vernal pools near a road, and ONE of the vernal pools far from a road)** by surveying along **North, South, East and West Transects originating from the focal vernal pool**. We will record the perpendicular distance of these new pools from the transects as well as the Coordinates of the vernal pools using GPS units. **Once the pools are located, we will revisit these pools THREE MORE TIMES** (at weekly to biweekly intervals) for a total of **FOUR VISITS to EACH VERNAL POOL**. **DURING EACH VISIT**, we will determine whether amphibian species are present using **VISUAL ENCOUNTER SURVEYS** (walking the perimeter of the pool and into the pool if necessary), listening for **CHORUSING**, and looking for **EGG MASSES, SPERMATOPHORES, or other evidence of presence**. Our focal species again are wood frogs and spotted salamanders, but record ALL amphibian and reptile species you see at each vernal pool.

The circle around each focal vernal pool is 500 m in diameter. In order to initially find vernal pools in this area around the focal vernal pool, walk 250 m in all four cardinal directions to locate vernal pools that you observe or hear. Use **binoculars** to help you locate pools, as well as listen for chorusing. It is very important to **Record the Perpendicular Distance from the transect to any Vernal Pools you find. Record the GPS location of the vernal pool and record ALL SPECIES observed in the Pool onto the “Percent Vernal Pool Occupied Data Sheet.”** Once you have completed the first transect (e.g., 250 m to the North), retrace your steps and return to the focal vernal pool. Then walk 250 m South from the focal vernal pool, again recording any vernal pools observed from this transect and recording presence of species. Repeat the same procedure heading E and W from the vernal pool.

FOCAL VERNAL POOL EGG MASS COUNT DATA SHEET

Front Side of Data Sheet

LOCALITY: Name of Refuge or Park (e.g., Great Bay NWR, Acadia National Park)

VERNAL POOL NAME: Name of specific pool being surveyed (e.g., Beech Pool # 1, Ken’s Pond)

DATE: Write out MM DD YYYY (e.g., 03 22 2001). **NOTE:** It is critical that egg mass counts occur on the same day.

TIME BEGIN: Use the 24 hour clock (e.g., use 13:20 = 1:20 pm). Write down the time the egg mass count survey begins. Begin and end times only cover the time actually spent searching for and counting egg masses and recording other organisms, not time spent collecting habitat or environmental data.

TIME END: Use 24 hour clock (e.g., use 15:00 = 3:00 pm)

GRID SPACING IS: Indicate the distance in meters between the lines on the grid. This necessitates measuring the maximum length and width of the pond **BEFORE** you begin the survey, so that you have a more accurate site map. Indicate the direction North with an N and arrow on the map.

OBSERVER 1: Write down the full name of OBSERVER 1 (the person who starts out the survey as Observer 1).

OBSERVER 2: Write down the full name of OBSERVER 2 (the person who starts out the survey as Observer 2).

SPECIES: Use **W** for **WOOD FROG** and **S** for **SPOTTED SALAMANDER** egg mass areas. As you circumnavigate around and in the pond, label areas where **WOOD FROG egg masses** are found as **W1, W2, W3**, etc. Label areas where **SPOTTED SALAMANDER egg masses** are found as **S1, S2, S3**, etc. Observer 1 determines what constitutes an egg mass area. Put these in the species column with corresponding Observer 1 and 2 counts.

EGG MASSES OBSERVER 1: Observer 2 records the number of egg masses Observer 1 sees within an egg mass area.

EGG MASSES OBSERVER 2: Observer 2 records any additional egg masses that Observer 1 missed.

DEAD: Check this space if you observe that $\geq 50\%$ of the embryos in an egg mass area are dead (dead embryos are often white or fuzzy, exhibiting fungal growth). Otherwise, leave it blank.

Back Side of Data Sheet

LOCALITY: Name of Refuge or Park (e.g., Great Bay NWR, Acadia National Park). Include the name of the subdivision or subunit if such exists (e.g., Great Meadows-Oxbow).

VERNAL POOL NAME: Name of specific pool being surveyed (e.g., Beech Pool # 1, Ken's Pond)

DATE: Write out MM DD YYYY (e.g., 03 22 2001)

SKY CODE: Do not conduct surveys if sky codes are 6 or above!! The codes are as follows:

Code	Sky Condition
0	Clear or few clouds (< 20% of sky)
1	Partly cloudy or variable (20-50% of sky)
2	Cloudy or overcast (> 50% of sky)
3	Fog
4	Mist
5	Showers or light rain
6	Heavy rain
7	Sleet/Hail
8	Snow

WIND CODE: Do not conduct surveys if wind codes are 6 or above!! The codes are as follows:

Code	mph	Indicators of Wind Speed
0	< 1	calm, smoke rises vertically
1	2-3	light air movement, smoke drifts
2	4-7	light breeze, wind felt on face, leaves rustle
3	8-12	gentle breeze, leaves/twigs in constant motion, raises dust
4	13-18	moderate breeze, small branches move
5	19-24	fresh breeze, small trees begin to sway
6	25-31	strong breeze, large branches move
7+	> 31	strong winds

PREVIOUS DAY PRECIPITATION: Check one of the boxes as to whether precipitation did (Yes) or did not (No) occur in the past 24 hours.

AIR TEMPERATURE: Collect air temperature in the shade at breast height one foot from the water's edge. Check the box to indicate either Centigrade or Fahrenheit scale.

WATER TEMPERATURE: Collect water temperature in the shade within the pool one foot from the shore at a depth of 2 cm. Check the box to indicate either Centigrade or Fahrenheit scale.

POOL MAXIMUM DEPTH: Install a dowel rod (5/8" x 48") where you estimate it to be the deepest part of the vernal pool. Each time you visit the site, wade out to the dowel rod to record the water depth at that location. Record in centimeters using a meter stick.

WATER LEVEL: Check whether the vernal pool is full, $\frac{3}{4}$ full, $\frac{1}{2}$ full, $\frac{1}{4}$ full, $< \frac{1}{4}$ full, or dry. You will be able to gauge this by knowing the site's water extent or by looking for water marks or moss growing at the base of trees or the extent of area near the water covered by damp mud or darkened, dried crinkled leaves.

IS VISIBILITY IMPAIRED DURING EGG MASS COUNTS?: Check Yes or No, if visibility is impaired, for example, by excessive water cloudiness (silt) or darkness (tannic acids), etc.

OTHER AMPHIBIANS, REPTILES, INVERTEBRATES, ETC.: For Amphibian and Reptile species, write in the species observed and estimate the numbers of mated pairs, egg masses, juveniles or adults observed, or check whether spermatophores or tadpoles/larvae were seen. Please include **ALL vertebrates or invertebrates** that were seen at the pool (consult "A Field Guide to the Animals of Vernal Pools"). If frogs or toads were heard calling, write in which species were chorusing and use the Chorus Codes below. For Chorus Code 3, simply record 3. For Chorus Codes 1 and 2, record the Chorus Code as well as an Abundance Count in parentheses following it. For example, if you hear a chorus code of 2 and estimate 6 spring peepers calling, write down Spring Peeper under Species and 2(6) under Chorus Code.

Chorus Code	Description
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0	No amphibians calling.
1	Individuals can be counted, calls not overlapping. Assign this number when individual males can be counted, and when the calls of individuals of the same species do not overlap. For the <i>Abundance Count</i> , record the number of individual frogs of each species calling.
2	Calls distinguishable, some simultaneous calling. This code is assigned when there are a few males of the same species calling simultaneously. However, with a little work, individual males can still be distinguished. The exact number of individuals may not be determined, but a reliable estimate of the number of individuals can be determined based on the location of the calls and/or by differences in the voices calling. Therefore the <i>Abundance Count</i> , is an estimate of the number of individuals calling.
3	Full chorus, calls continuous and overlapping. This value is assigned when there are so many males of one species calling that all the calls sound like they are overlapping and continuous. There are too many overlapping calls to allow for any reasonable count or estimate, therefore an <i>Abundance Count</i> is not recorded.

NOTES: In this section include any other observations of interest. Also, if you run out of room on the front part of the data sheet, you can use this section for additional data collection on egg mass numbers.

FOCAL VERNAL POOL LOCATION AND HABITAT DATA SHEET

This data sheet only needs to be filled out **ONCE** at each of the FOCAL VERNAL POOLS at the time when the maximum numbers of eggs are observed. It is also important to **TAKE PHOTOGRAPHS** at this time of the vernal pool.

LOCALITY: Name of Refuge or Park (e.g., Great Bay NWR, Acadia National Park)

VERNAL POOL NAME: Name of vernal pool being surveyed (e.g., Beech Pool # 1, Ken's Pond)

OBSERVER: Write your full first name and last name (e.g., Laurie Wunder).

DATE: Write out MM DD YYYY (e.g., 03 29 2001).

DETAILED DIRECTIONS TO SITE: Describe the specific geographic location of the site. Use air distance in two directions (e.g., 5 km N and 7.5 km W) of a map landmark that likely will not change. For example, "500 m NW from American Holly Drive 0.2 km W of gate entrance."

UTM ZONE: Record Zone in which pool occurs (e.g., Zones 17, 18, or 19 in Northeastern U.S.).

UTM DATUM: Record Datum using NAD83 only!

UTM EASTING: e.g., 342325 (six digits) Take Coordinates at the northernmost point of the pool.

UTM NORTHING: e.g., 4702503 (seven digits) Take Coordinates at the northernmost point.

LATITUDE: Record as degrees minutes and decimal seconds (DD°MM'SS.SS").

LONGITUDE: Record as degrees minutes and decimal seconds (DD°MM'SS.SS").

ELEVATION: Record elevation of site. Check the box if units are in meters or feet.

POOL MAXIMUM LENGTH: Record using a meter tape (e.g., 14.2 m). Check the box if units are in meters or feet.

POOL MAXIMUM WIDTH: Record using a meter tape (e.g., 5.5 m)

POOL MAXIMUM DEPTH: Install a dowel rod (5/8" x 48") where you estimate it to be the deepest part of the vernal pool. Each time you visit the site, wade out to the dowel rod to record the water depth at that location. Record in centimeters using meter stick.

POOL PERMANENCY: Check if pool is temporary, semipermanent, or permanent.

POND TYPE: Check if pool is Natural, Beaver-created, Artificial/Man-made, or Unknown. If Artificial/Man-made, check the box that best applies (e.g., borrow pit, roadside ditch, etc.).

SITE TYPE: Classify site type by whether it is upland-isolated, bottomland-isolated, or part of a wetland complex. Check box that best applies.

FISH PRESENT: Record if fish are absent (No) or present (Yes). If Yes, record species observed.

DISTANCE TO FOREST FROM WATER'S EDGE: Record distance (in meters or feet, checking appropriate box) from the pool water's edge to the nearest forest/woodland.

DISTANCE TO NEAREST ROAD: Record distance to nearest road in m or ft (check box that applies)

ROAD IS: Check whether road is paved, gravel, or dirt.

ROAD CONDITIONS AT NIGHT: Record whether nearest road to site experiences light (< 10 cars) or heavy (≥ 10 cars) traffic at night.

AQUATIC SUBSTRATE: Record abundance categories (0 = 0%, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, 4 = 51-75%, 5 = 76-100%) for leaf litter and sticks/logs which are found in or cover the bottom of the pool (these do not sum to 100%).

AQUATIC VEGETATION: Record abundance categories (0 = 0%, 1 = 1-10%, 2 = 11-25%, 3 = 26-50%, 4 = 51-75%, 5 = 76-100%) for each of the following in the pool (these do not sum to 100%):

SAV (Submerged Aquatic Vegetation)

Herb (includes moss, grasses, forbs, ferns, graminoids)

Emergent (includes sedges, rushes, arrowhead, etc.)

Cattail

Shrub

Tree

Other

LAND USE/COVER AROUND VERNAL POOL: Estimate % of each land use/cover types within 50 m (165 ft) of pool. Estimates must sum to 100%.

% Woodland/Forest – If woodland/forest surrounds vernal pool, check whether it is dominated by hardwood, softwood, or mixed forest. Also check whether canopy cover over the vernal pool is heavy (> 50%) or moderate (< 50%).

% Agriculture/Fields

% Meadow/Marsh

% Residential/Urban/Suburban

% Industrial

% Mining

% Pasture/Rangeland

% Road

% Other (specify other if this applies)

NOTES: Include any observations about the site you think pertinent.

PERCENT VERNAL POOL OCCUPIED DATA SHEET

LOCALITY: Name of Refuge or Park (e.g., Great Bay NWR, Acadia National Park)

FOCAL VERNAL POOL NAME: Name of specific pool being surveyed (e.g., Beech Pool # 1, Ken's Pond)

OBSERVER: Write down the full name of the observer(s).

DATE: Write out MM DD YYYY (e.g., 03 22 2001). **NOTE:** It is critical that egg mass counts occur on the same day.

TRANSECT: Circle if the vernal pool was located off the North, South, East or West Transect.

VERNAL POOL #: As you search along the transects, number the vernal pools you encounter sequentially.

DISTANCE FROM TRANSECT: Record the perpendicular distance from the Transect to the Vernal Pool.

Fill out the remaining variables in the same manner as on the other data sheets.

SPECIES TABLE SECTION: For Amphibian and Reptile species, write in the species observed and estimate the numbers of mated pairs, egg masses, juveniles or adults observed, or check whether spermatophores or tadpoles/larvae were seen. Please include **ALL vertebrates or invertebrates** that were seen at the pool (consult "A Field Guide to the Animals of Vernal Pools"). If frogs or toads were heard calling, write in which species were chorusing and use the Chorus Codes below. For Chorus Code 3, simply record 3. For Chorus Codes 1 and 2, record the Chorus Code as well as an Abundance Count in parentheses following it. For example, if you hear a chorus code of 2 and estimate 6 spring peepers calling, write down Spring Peeper under Species and 2(6) under Chorus Code.

FIELD EQUIPMENT

Rite-in-the-Rain paper

Data sheets

Pencils

Clipboard

Polarized Sun Glasses (2)

50 m fiberglass meter tape

Thermometer for air and water temperatures
 Dowel Rod 48" x 5/8" (1 per focal vernal pool)
 Hammer or Rubber Mallet (to pound in dowel rod)
 Field Guide to the Animals of Vernal Pools
 Reptiles and Amphibians Eastern/Central North America, Peterson Field Guides
 Protocol Write-up
 Binoculars
 Compass
 Watch
 Meter stick
 GPS Unit/PLGR (1)
 Sharpies

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